PATENT SPECIFICATION

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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to Apparatus for Determining Variations in Width of Travelling Transparent Birefringent Film.

We, BRITISH CELLOPHANE LIMITED, a British Company, of Bath Road, Bridgwater, Somerset, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for determining variations in width of travelling transparent birefringent films, such as films of regenerated cellulose.

In our British Patent Specification No. 627,228, there is described an apparatus for gauging film width variations in a travelling length of transparent birefringement film comprising two identical detecting heads, one for each edge of the film, for detecting the position of the film edges. Each detecting head comprises a source of light which is plane polarised by a polarising means and directed at a second polarising means set for extinction of the light, behind which a photoelectric cell is placed. When an edge of the film intersects the beam of light passing between the two polarising means, the light passing through the film is elliptically polarised and passes through the second polarising means to the photoelectric cell. Thus, the light received by the photocell is a measure of the area of the film intersecting the beam of light and variations in the total light received by both photoelectric cells in the detecting heads is a measure of the variations in width of the travelling film.

For the successful operation of this apparatus, the light transmission of the film and the degree of birefringence must be reasonably constant to avoid spurious width variation signals. However, these properties often vary, particularly in the region of the beads at the edges of the film.

The object of the present invention is to provide an improved apparatus for determining variations in width of a travelling birefringent film which is substantially unaffected by small variations in light transmission and in the degree of birefringence of the the film.

Accordingly, the present invention includes an apparatus for determining variations in the width of a travelling birefringent film which apparatus comprises two edge detecting beads, one for each edge of the film and a signal integrator for summing signals received from both heads, each detecting head including a light source, a first polarising means for plane polarising light emitted from the light source, a second polarising means so oriented that it extinguishes light passing directly from the first polarising means, at least two photoelectric cells capable of being activated by light passing through the second polarising means and spaced apart in a direction transverse to the direction of travel of the film, the first and second polarising means being separated to provide a passage-way through which a film edge may travel and intersect the light passing from the first polarising means to the second polarising means and each photoelectric cell being connected to the integrator so that when the cell is activated by light a signal is conveyed to the signal integrator.

When there is no film intersecting the path of light in a detecting head, no light reaches the photoelectric cells because of the complete extinction provided by the second polarising member. However, when a film edge completely or partly intersects the path

of light, the portion of the light passing through the film is, by virtue of the birefringent property of the film, elliptically polarised and will pass through the second polarising member and activate the photoelectric cells in the path of that portion of light.

In the use of the apparatus in accordance with the invention, the two detecting heads are set apart by a distance such that the edges of the film each intersect about one half the light beams in each of the detecting heads. Thus, about half of the photoelectric cells in each of the heads are activated by the light passing through the area of the film intersecting the light path. As the film passes through the detecting heads it may tend to swing laterally, but providing that it is of constant width, the total number of photoelectric cells which are activated in the two detecting heads will remain substantially constant. However, if the film width decreases, the total number of activated photoelectric cells will decrease; similarly, with increase in film width, the total number of activated photoelectric cells will increase.

The apparatus in accordance with the invention can operate with a minimum of two photoelectric cells in each head placed next to each other on a line passing transversely across the film. Such an arrangement, however, is insensitive to small width changes. Where higher sensitivity is required, it is necessary to increase the number of photoelectric cells per unit length along a line transverse to the path of travel of the film.

Even higher sensitivity is obtained in the preferred form of the invention in which two or more parallel rows of photoelectric cells are arranged transverse to the path of travel of the film, the photoelectric cells in each row being staggered with respect to cells in adjoining rows.

Each of the photoelectric cells may be directly connected to a highly sensitive integrator such as a microammeter capable of measuring the current emitted by the light activated cells. More preferably, however, the photoelectric cells are each connected to the integrator through a signalling means which emits a signal when the photoelectric cell is activated by light. A convenient signalling means is a gas filled trigger valve which strikes and passes a predetermined electric current when the associated photoelectric cell is activated by light. The total current flowing from all the trigger valves in both heads may readily be determined by connecting all the trigger valves to a single ammeter, the reading of which will be a measure of all the photoelectric cells receiving light and hence a measure of the width of the film. The ammeter is preferably of the self-recording type which traces a continuous record on a moving chart from which variations in the width of the film may readily be obtained.

The signalling means may also be either a mechanical or hydraulic device operated by the electric current flowing through the photoelectric cell when activated by light when the integrator is a device capable of summing the mechanical and hydraulic signals.

Examples of transparent birefringent films whose variations in width may be determined by the apparatus in accordance with the present invention are regenerated cellulose film, films of cellulose acetate, cellulose nitrate, polyvinyl alcohol, rubber hydrochloride, polyethylene, polypropylene, polyamides, and polyesters.

A specific example of an apparatus constructed in accordance with the invention will now be described with reference to the drawings accompanying the Provisional Specification, in which:—

Figure 1 is a diagrammatic layout of the apparatus;

Figure 2 is an elevation, partly in section, of a unit illustrated in Figure 1;

Figure 3 is a section throught line 3—3 of Figure 2; and

Figure 4 is a circuit diagram of the electrical part of the apparatus.

In Figure 1, a pair of identical edge detecting heads 1, 1[1] are disposed one on each side of a travelling transparent birefringent film 2, for example a regenerated cellulose film, such that each film edge passes between a light emitting wing 3, 3[1] and a light receptive wing 4, 4[1] of one of the detecting heads 1, 1[1].

Electrical signals from the receptive wings 4, 4[1] are passed to a relay unit 5 by conductors 6, 6[1], where by means to be described below, there is produced an electric current which is a measure of the width of the film 2 passing between the heads 1, 1[1]. The current is continuously recorded on a chart 7 by a recording ammeter 8.

The light emitting wing 3 (Figure 2) of each of the detecting heads 1, 1[1] is fitted with four festoon-type electric bulbs 9 from which light is directed across the gap traversed by the edge of the film 2, to the light receptive wing 4 through a diffusing screen 10, a first light polarising sheet 11 and a protective glass sheet 12. The diffusing screen 10 ensures that the intensity of the light is as uniform as possible and the polarising sheet 11 causes the light leaving the wing 3 to be plane polarised. A suitable light polarising sheet is the polarising sheet material sold under the Registered Trade Mark "Polaroid".

The light receptive wing 4 contains a bank of thirty-two photoelectric cells 13, each cell 13 being separately housed in one of the thirty-two recesses 14 formed in a block 15

of opaque material. The photoelectric cells 13 are approximately ¼ inch in diameter and have light-receptive areas at the ends resting at the bottom of the recesses 14. The electric voltage supplies to the photoelectric cells 13 are provided by wires 16 passing through the conductor 6 from the relay unit 5 (shown in Figure 1).

Light conducting channels 17 are drilled in the block 15, one to the base of each recess 14, to permit light passing from the wing 3 to penetrate to the photoelectric cells 13 and so energise the cells 13.

The recesses 14 with the associated channels 17 are arranged in eight parallel rows of four recesses 14 each along lines transverse to the path of travel of the film 2. Further, the recesses 14 and channels 17 (Figure 3) are staggered in the rows with respect to recesses 14 and channels 17 in adjacent rows.

Interposed in the path of the plane polarised light passing from the wing 3 towards the channels 17 is a protective sheet of glass 18 and a second light polarising sheet 19 so oriented with respect to the first polarising sheet 11 that the plane polarised light passing from the wing 3 is extinguished and prevented from reaching the photoelectric cell 13 by way of the channels 17.

Each of the photoelectric cells 13 is associated with a gas filled triode valve 20 (sometimes known as a trigger valve) in the relay unit 5 as shown in the circuit diagram in Figure 4. The cells 13 are supplied with 250 volts direct voltage between lines 21, 22 and on a current passing due to light reaching and energising a cell 13, a voltage drop occurs across a resistor 23 in the circuit incorporating the cell 13.

The triode valves 20 are supplied with an alternating unidirectional voltage of 150 volts between the lines 24, 25 and are normally in a non-conducting state. However, when a voltage drop across a resistor 23 occurs, as described, the grid of the associated triode 20 becomes more positive, the valve 20 strikes and a current flows in the triode valve circuit until the associated photoelectric cell 13 is no longer energised by light and the grid potential thereby becomes less positive. The current flowing through each of the triode valves 20 is pre-set at the same value for each valve 20 by means of variable resistors 26 so that the total current passing through the recording ammeter 8 connected between lines 22, 25 is directly proportional to the number of triode valves 20 conducting at any one time and hence, the number of photoelectric cells 13 energised at any one time.

The apparatus operates as follows:—

The detecting heads 1, 1¹ are placed one on each side of the path of the film 2 so that the edges of the film 2 enter about halfway into the spaces between the light emitting wings 3, 3¹ and the light receptive wings 4, 4¹. As explained above, in view of the orientation of the first and second polarising sheets 11, 19 with respect to each other, the plane polarised light from the wing 4 is extinguished before it can reach the channels 17. However, the plane polarised light passing through the film 2 is, by virtue of the birefringent property of the film, elliptically polarised and is not extinguished by the polarising sheet 19. This portion of the light enters the channels 17 directly above the film 2, energises the corresponding photoelectric cells 13 which in turn causes their associated gas filled triode valves 20 to strike and the total current from all the valves 20 associated with energised photoelectric cells 13 in both light receptive wings 3, 3¹ passes through the ammeter 8 and is recorded on the chart 7.

For a constant width of film 2, the number of energised photoelectric cells 13 and hence the current through the ammeter 8 will remain constant, even if the film 2 sways from one detecting head 1 towards the other head 1¹. However, if the film width decreases, the portion of the light from the wing 3 (3¹) passing through the film decreases, the number of energised photoelectric cells 13 decreases and hence the current through the ammeter 8 decreases. Similarly, an increase in width of the travelling film 2 causes the current through the ammeter 8 to increase.

Consequently, the recording on the chart 7 will indicate the variations in the width of the film 2 passed between the detecting heads 1, 1¹. By trial runs, the recordings may be related accurately to true width measurements.

The reading of the ammeter 8 is quite independent of variations in light transparency or degree of birefringence of the film 2 since it depends upon whether or not light is received by the photoelectric cells 13 and not upon the intensity of the light.

By staggering the positions of the photoelectric cells 13 in the block 15 as shown by the position of the channels 17 in Figure 3, the sensitivity of the apparatus to change of position of the film edge is increased.

The apparatus is of particular use for determining the minimum width of rolls of film which are to be slit into reels of shorter length. By examination of the chart 8, the operator is able to determine the maximum length of reels which can be slit from the parent roll with the minimum of waste.

WHAT WE CLAIM IS:—

1. An apparatus for determining variations in the width of a travelling birefringent film comprising two edge detecting heads, one for each edge of the film and a signal integrator for summing signals received from

both heads, each detecting head including a light source, a first polarising mians for plane polarising light emitted from the light source, a second polarising means so oriented that it extinguishes light passing directly from the first polarising means, at least two photoelectric cells capable of being activated by light passing through the second polarising means and spaced apart in a direction transverse to the direction of travel of the film, the first and second polarising means being separated to provide a passageway through which a film edge may travel and intersect the light passing from the first polarising means to the second polarising means and each photoelectric cell being connected to the integrator so that when the cell is activated by light a signal is conveyed to the signal integrator.

2. An apparatus as claimed in Claim 1 in which each photoelectric cell is connected to the signal integrator through a signalling means which emits a signal on the photoelectric cell being activated by light.

3. An apparatus as claimed in Claim 2 in which the signalling means is a trigger valve.

4. An apparatus as claimed in Claim 1, claim 2 or Claim 3 in which the signal integrator is an ammeter.

5. An apparatus as claimed in Claim 4 in which the ammeter is a recording ammeter.

6. An apparatus as claimed in any one of the preceding claims in which in each detecting head, the photoelectric cells are arranged in two or more parallel rows transverse to the path of travel of the film and the photoelectric cells in each row are staggered with respect to photoelectric cells in adjoining rows.

7. An apparatus as claimed in Claim 1 substantially as described with reference to the drawings accompanying the Provisional Specification.

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956636 PROVISIONAL SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*